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ABSTRACT

Bond valuation is examined to provide college administrators a more thorough understanding of the process to help them in developing their market values, or to help them in moving to a market valuation on bond holdings. Two methods presently used to value bonds, a matrix system and a trader quotation method, are described. An overview of bond markets and a discussion of dealer quote versus matrix pricing are presented. Features important to educational institutions when considering a bond-pricing service are considered. The two services that are the best-known evaluation of debt issues in the United States are Moody's and Standard and Poor's. Salomon Brothers is probably the largest bond trading house in the world, with the most comprehensive organization of bond traders. Additional services described are provided by: Kuhn Loeb, Digital Information Corporation, Interactive Data Services, Inc., Telstat, and Merrill Lynch. (SW)

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Bond Valuation for Colleges & Universities

National Association of
College and University Business Officers

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Preface

FOR SEVERAL YEARS there has been a debate concerning the valuation of bonds (also called debt securities or fixed-income securities). This debate has mostly been within the narrow confines of professional bond managers and traders, but at times it has included those responsible for administering, and accounting for, large pools of capital, including endowment funds.

Most administrators of college and university endowment funds accept the argument that investment securities should be priced "at market." More often than not, however, financial statements of educational institutions show a recorded cost, and parenthetically note or footnote the value of securities at market. What most administrators do not know is that there is a keen debate over what is proper market valuation.

Admittedly, the subtle technical concerns of proper bond valuation are limited to a very few. Limited interest, however, should not change the fact that administrators should understand the valuation process and endeavor to seek proper valuation. The NACUBO Investment Committee believes it important to address this issue in order to improve the quality of reporting on investments. A more thorough understanding of the valuation process should give educational administrators more comfort in developing their market values, and where this is not yet the case, should help in moving to a market valuation on bond holdings.

The project to develop this paper was made possible by a grant from the Ford Foundation, enabling NACUBO to have another "how to" study available to institutions. Members of the Investment Committee also hereby acknowledge James L. (Rocky) Barber of Stanford University, who undertook this project and drafted the monograph.

April 30, 1977

NACUBO Investment Committee

Introduction

THE 1974 and 1975 NACUBO Comparative Performance Studies (CPS) contained questions concerning the valuation of bond assets in endowments. It was clear that many respondents were not satisfied with the existing valuation approaches. In the 1976 CPS, nine institutions out of 129—six of which had assets over $100 million—indicated dissatisfaction with bond pricing methods. Specific enumeration of methods used by individual institutions revealed many different valuation methods, with the greatest percentage of respondents indicating that they value their bonds "at market." Surprisingly, the next most common response was that bonds were valued "at cost." Fewer institutions mentioned other methods, which involved some attempt to value bonds at market through a specific brokerage house or commercial pricing service. Other institutions indicated that outside advisers or banks did the valuations, and these were blindly accepted.

Within the bond management community there is debate about the accuracy and quality of bond valuations, of which not all endowment fund managers are aware. The purpose of this monograph is to examine the various methods and services currently used in bond pricing, including a detailed examination of each service. Strong points of each are compared to a list of desirable features appropriate for the valuation of bond assets of educational institutions. With this approach each manager can understand the problem and determine which would be best for his or her institution.

In recent years the greater attention paid to bond performance has meant that bond managers must price all their issues at least quarterly, and in most cases, monthly; formerly, many issues were checked only annually. This, coupled with rapidly expanding total outstanding corporate debt, has resulted in increased requests for valuations and in the formation of several new services.

The controversy centers on two methods presently used to value bonds, and the impact each has on performance. Most of the newer services value by a matrix system, whereas the older services use the better-known trader quotation method. Both methods are more fully described later herein.

Older services have expanded coverage of issues, and simply spend more time gathering dealer quotations from more trading institutions. This has meant an

increasing chance of error by the traders, who must now value a greater number of issues, and by the pricing services, which must correctly record, transfer, and disseminate this much greater amount of information.

Newer services have attempted to reduce this workload by directly pricing only a small percentage of the bond market. By accurately pricing a broad spectrum of well-known and liquid issues and then using a framework called a matrix, traders can give the computer rules to interpolate values of any bond encompassed in that spectrum. This method may be slightly less accurate than trader quotations for bonds that have only little liquidity and where the trader may have a fairly recent trade on which to base the valuation. However, matrix valuation is much less work (long-run lower cost), and any issue, no matter how illiquid, can be reasonably and consistently valued.

Recent legal developments have added to the controversy. Congress passed the Employees Retirement Income Security Act (ERISA) in 1974. This act makes clear a manager's liability for anything other than the prudent management and valuation of assets. To supporters of the older dealer quote system, ERISA means that each individual bond valuation must be more carefully checked. Indeed, some managers now obtain two or three valuations in an attempt to eliminate the poorer quotes. A manager who uses a system where a machine computes most of the prices, replacing the individual dealer quotation, seems much more vulnerable to a lawsuit.

On the other hand, advocates of matrix pricing point to the lower expenditure of time and money in their method. A prudent man would not waste the time and money involved in individual evaluations that might still be inaccurate. Matrix pricing is also more comprehensive and uniform. This is especially true for smaller, illiquid issues where broker quotes have historically had problems due to insufficient trading information, whereas the computer can follow a consistent and unbiased set of rules. Matrix advocates argue that it is not the small valuation errors that cause lawsuits, but rather the badly mispriced bonds such as a small illiquid issue where matrix pricing gives better results.

The use of a bond's cost as a substitute for its current market value is still widespread. Historically, bonds have been purchased and set aside, to be held for long periods of time, most often until maturity. The interest received was the only relevant source of return. For many years before the 1970s, even if bondholders had paid attention to the capital portion of their bonds, the current value, it would have been of little concern, since bond prices remained quite stable.

As the inflation rate rose in the late 1960s, the coupon rate for new bond issues moved up significantly. The opportunity lost by holding older, lower-coupon bonds became increasingly apparent. Instead of 4% or 5% coupons, new bonds paid 7% and 8%. As interest rates peaked in the early 1970s and the stock market moved lower, investment activity in bonds increased. A large range of coupon rates was available, and greater interest meant increased liquidity, making trading more feasible. Just as equities had done earlier, bonds became the object of a

heavy push for performance. This also tended to increase bond trading, with professional managers seeking ways to increase yield or total return, or both.

As institutions found the income from their old bonds low compared to new offerings, many attempted to trade their 4% coupon bonds for 7% and 8% issues, only to find that the value of the bond they had held at cost was actually significantly decreased. This loss became more apparent as the cost of goods, purchased with the level interest income from old bonds, rose until the income could not buy the same goods. Programs that had been completely supported by these bond interest payments had either to seek additional sources of funding or to liquidate the bond principal at its greatly reduced value, recording a loss in the transaction.

In other words, valuation at cost did not reflect actual value, and hid the loss to the portfolio. Valuing bonds at market value gives a true reflection of both present and future prospects of achieving investment objectives. Carrying bonds at cost simply ignores the impact of inflation and interest rate rise on present and future budgets as well as other financial objectives. Furthermore, this procedure totally ignores the question of performance and renders any computed performance figure meaningless.

It should be noted that the future performance of old bonds with low coupons is a heavy drag on a tax-exempt institution's bond portfolios. Since discount bonds have a capital gains portion, taxable investors are willing to pay more for these bonds to gain favorable tax treatment. With a higher price, these bonds have a lower yield to maturity. For educational institutions both income and gain on a bond is nontaxable, so there is no reason to pay a premium for the capital gain. Such institutions should try to maximize the yield to maturity of their bonds, and this means trading old, low-coupon bonds for current coupon issues. While a loss is realized, this is purely historical: the loss is there, whether realized or not. If the institution continues to hold the low-coupon bond, it is assuring itself of inferior future performance, since these issues have lower total return and yield to maturity than the same bonds with a current coupon.

While some professional bond managers dislike the heavy emphasis placed on performance, very few object to valuing portfolios at current market price. The single, glaring exception occurs in the life insurance industry, where the laws of many states require that assets be reported at cost. There is some justification for this procedure here because the industry has noninflating, fixed, future liabilities that can be directly offset by fixed, future asset contracts. Recently, however, the Financial Accounting Standards Board (FASB) has begun requiring that all companies, including insurance companies, ascertain and disclose the current market value of bond portfolios in their financial statements. (Not-for-profit organizations are excluded from this requirement.)

Many institutions have resisted the movement to value bonds at market rather than at cost because a large percentage (15% or 20% in some cases) of their paper assets would disappear. Educational institutions should realize that whether or not they show it on paper, they may have a significant loss of purchasing power in their bond portfolios. For present operations and performance as well as planning, market valuation is the only dependable method.

The Bond Markets

VALUATION OF BOND SECURITIES is difficult from the very start. Unlike equities markets, where most issues are listed and trading is reported, only about 2,500 bond issues are listed in a universe of over 10,000 public issues. If private placements are added, the figure would run upwards of 100,000 issues, and if municipal bonds are included, into the millions. Because the bond market is so broad, there is very little depth or liquidity in any but a few hundred well-known issues. Outside of these, a bond may not trade for weeks or months, and even then would probably go unreported because the issue is not listed.

Trading on the New York Bond Exchange, or "Big Board," in listed bonds represents less than 2% of total bond trading. The Big Board has long been the place for odd-lot trading of bonds (10 bonds, or $10,000, is considered a large trade), and usually only one-third of the listed issues trade in a given day. Because the Exchange is only a very small part of the bond market, and represents only odd-lot trading on those issues, quotes based on Big Board trades are likely to be misleading. Odd-lot traders must do a great deal of work and carry some risk from holding bonds while assembling a round lot, so odd lots sell at lower prices than round lots of the same bond. The difference can range from almost nothing to two or more points for less liquid issues. Thus, while some Big Board prices may be reasonable proxies for round-lot trading, many others may be biased downward by several points.

Most bond trading is institutional round-lot activity, where a round lot means at least 100 bonds ($100,000 par value), and usually 250 bonds. Some brokers and traders prefer to deal only in units of half a million or a million dollars, and will quote slightly better prices for these larger lots. While bonds do not trade as often as stocks, the much larger average trade size means that dollar trading in bonds exceeds the total dollar value of all stocks traded. Trading in bonds is far less expensive and much less risky because a bond is a fixed contract representing real cash flow for both principal and interest, whereas a stock carries only a current dividend, with no legal promise for any other form of return, either future dividends or any capital recovery.

Another major distinction between equity and bond markets is that most better-known stocks are traded in centralized auction. Buyers and sellers of a

particular security gather in one place, and sellers auction their stocks to the highest bidder. The greatest merit of this system is that the seller deals directly with the buyer, while the broker usually acts only as an agent for the trade. Since the system is so centralized, trades are easily recorded, and information flows quite freely. The bond market, on the other hand, is a large, decentralized "specialist" or "dealer" market. In this system of securities trading, a seller must go to a dealer or trader who in turn must find a buyer. The dealer may do one of three things: first, he may try to find one of his own clients who wishes to buy the security; secondly, he may buy the security for his own inventory, or thirdly, he may call what is essentially a broker's broker, a bond trading house that acts as liaison among other houses. Since this market has no direct hookup between buyers and sellers, the dealer is most often called on to take a position, i.e., to act as a temporary resting place for the securities involved. The dealer will buy the bonds from the seller and immediately begin searching for a buyer or buyers. For this system to function efficiently, dealers must carry large inventories of bonds. To keep inventories from becoming unmanageable, many bond trading houses specialize in a particular kind of bond. This also makes it easier for buyers and sellers of that particular kind of bond to find each other. Salomon Brothers, probably the world's largest bond trading house, has an inventory that runs into the billions of dollars. Salomon makes itself a continuous marketing place for several kinds of bonds. Buyers know that if they wish to trade government issues, Salomon always stands ready to make a market in any such bond or note.

An unusual consequence of this kind of trading is the lack of a pricing system. Because there are many specialists, several bond trading houses may trade a particular issue. One house may find a buyer and seller at one price, while another may complete a trade at a different price. If these trades take place simultaneously, what is the real price of that bond? The existence of wholesale bond houses dealing exclusively among bond brokers keeps the probability of such occurrences low, but it does happen.

As a second example, if a bond has not traded recently, the valuation must rely on somewhat subjective bid and asked prices for an unknown number of bonds. What good is a bid price for one bond to someone who wants to sell 100 or 1,000 bonds?

For a third problem, suppose a bond is so illiquid that there are no bidders at all. This does not, of course, mean that the bond has no value. The issue cannot be priced directly, but by comparing it to some very similar issue, a relative difference can be assigned, and this difference added to or subtracted from the price of the similar bond to calculate the value of the unknown issue.

The first two problems are most often solved by obtaining quotes for specific issues directly from bond dealers. These quotes do not represent an offer to buy a bond at a particular price, but are what the dealer feels from his trading knowledge (which may include several recent trades) to be a reasonable price for the bond.

The third problem, however, can be solved in a comprehensive fashion through the use of a matrix pricing system, in which various well-known issues are

priced directly and relative scales are set up that add or subtract value to arrive at a price for bonds similar to the well-known issues.

All three problems are the result of noncentralization and nonreporting of trade prices. If trade prices were reported, then bid-ask spreads by brokers could be confirmed directly. Issues without trade or bid-ask prices could be accurately priced by their spread from other issues having reported bid and trade prices.

In 1974 the Bond Portfolio Managers Association (BPMA) proposed a system called UBAS (Uniform Bond Appraisal System), which it hoped would become standard for bond pricing. This system essentially would have taken the place of a centralized market by having anonymous reporting of all trades over $250,000. Also, brokers and dealers throughout the country would be asked to spend up to one man-hour per day submitting bid valuations for numerous bonds. Thus, with both valuations confirmed by actual trades on some bonds, and bid valuations for many that had not traded, a comprehensive matrix could be set up covering all issues, including those without reasonable bids. Given the constraints of illiquidity in many issues, the UBAS proposal represented a theoretically optimal pricing system.

Unfortunately, such a system would have two requirements: (1) a large investment in computer and software to run the comprehensive matrix, and (2) the cooperation of bond traders all over the country—more specifically, several of the larger ones who handle a great majority of business. Many small dealers supported the system and enough money was pledged to start the design stage. However, when several of the largest bond dealers indicated they opposed the proposal, no one was willing to put money into a system that would not be met by almost universal acceptance. The large houses opposed UBAS for a variety of reasons. Some had their own pricing products that they wished to preserve because they were profitable and added to their prestige; a system such as UBAS would certainly make these other pricing systems obsolete. Also, many traders did not like the idea of reporting their trades. Because of the large inventories involved, traders never wanted to make their net positions known. Suppose one trading house sold a large number of bonds to an outside buyer and had to report it. Most likely, the trade could be completed only by having the bond dealer take a short position in the issue. Other houses might now refuse to sell him that particular issue, knowing full well that physical delivery must take place within five days. Since a bond house does not like to keep large amounts of capital tied up in a single issue, and since it must cover such short positions dollar-for-dollar with government securities or cash, it would probably be forced to bid up the price of that bond to cover the short sale. The UBAS proposal included the reporting of trades on an anonymous basis in an effort to solve this problem. In addition, specific price data would be revealed only on a lagged basis. Even with these safeguards, many bond trading houses still disliked the idea of disclosing trade prices or volumes. Apparently, bond traders will not reveal their trades until forced to, either by necessity or federal regulation. Since the UBAS proposal was turned down by the BPMA, a system like UBAS is not likely to get started in the near future unless dissatisfaction from all areas of securities trading (regulators, buyers, traders, banks, etc.) becomes apparent.

Dealer Quote Versus Matrix Pricing

THE MOST COMMON METHOD used for pricing bonds is dealer quotes, where one or more dealers are asked to price bonds in the portfolio. If the institution has few bonds and does little business with a broker, the broker will spend little time pricing those bonds. This is especially true if the issues are not well-known, and the dealer is not familiar with them; he will most likely arrive at a figure rapidly, considering only the coupon, maturity, and quality. For many bonds with special features, this can be a very poor pricing method. If the institution has a large portfolio, the trader pricing the bonds will likely determine the specifics of any unfamiliar holdings. This will give a reasonable valuation for the list of bonds. However, as is the case with most small brokers and traders, the company generally specializes in one area of bonds. While this can be an advantage in gaining expertise if the institution owns that type bond, it is a definite liability if the company is asked to price bonds in an area where it does not trade. The impreciseness of the pricing of the unfamiliar issues far outweighs the added precision achieved in issues they actively trade. To avoid this, many bond managers obtain prices from several traders, asking them to price only those bonds in which they are active.

Another method that can be used separately or in conjunction with this system is to obtain multiple quotes for each holding. This is actually a statistical sampling technique that makes use of the law of large numbers. If trader quotes give an unbiased estimate of the actual price and deviate from it by only small amounts, then the law of large numbers holds that the more observations made of the price, the more likely the average is to be close to the real price. While this may be a statistically valid technique, operationally it is cumbersome. For small portfolios, few brokers are consistently willing to give quotes for all the bonds held. For large portfolios, brokers may be willing to give quotes, but if three are used for each bond price, then it may take several hours or more to obtain and calculate the price of each bond. Also, many bond managers do not use a straightforward average of the three quotes they receive. Many will check each set of quotes to see if they are similar. If one differs greatly from the other two, it is discarded, and the remaining two are averaged for the final price. It should be noted that this is an incorrect statistical method. Assuming that the bond manager does not know in advance that one quote is inferior, then just because it differs substantially from

the other two does not make it incorrect or obviously inferior. The problem occurs because only a small number of samples is taken from the distribution. If one sample varies greatly from the other two, then it will unduly bias an average of the three. However, rather than drop it altogether, a better statistical method would be to use the median, or middle, price. While this is somewhat less accurate if the three samples are close together, it generally insures that no estimated price will deviate more than a point or so from the real price.

Use of the median price as an estimate of the real price of a bond is best where a bond manager must be reasonably confident of each individual issue price. ERISA legislation has left it unclear whether this is indeed the test of prudence. Many argue that it is the value and performance of the portfolio as a whole that is important. Present sentiment tends to be conservative and prefers the careful examination of each issue, but only time and the courts will resolve this "individual versus group" question. If the pendulum should swing in favor of the group view, then a change in the pricing method previously indicated would be warranted. A better overall portfolio value would be achieved by a straight averaging of all three values obtained for each issue. While some individual prices might be further off than if the median method were used, when all the different issues were added up, then the law of large numbers would be completely applicable and a better overall value of the portfolio would be obtained from the weighted average of the average price of all the issues.

While most auditors are more comfortable with a multiple quote system because it gives them relatively greater assurance of an accurate price, multiple quotes are probably not worth the effort for educational institutions where there is no great demand for statistically significant bond prices. Efforts should rather be directed toward consistency, obtaining quotes from brokers known as good traders in a particular issue, rather than from any brokerage house that will price the bond.

Matrix pricing is a relatively simple tool that, when fully implemented, can be elaborate and powerful, perhaps the only such tool for valuing a complete spectrum of debt issues. A very liquid market in bonds exists for some issues and a less liquid market in many thousands of others, where a bid and ask price generally can be obtained from a dealer. However, thousands of corporate issues and hundreds of thousands of municipals remain impossible to get a bid or ask price for, because no one is actively interested in buying or selling them. This does not mean that the issue does not have a price. Using a matrix pricing system, a reasonable value can be computed for any bond. Any system expected to be a complete representation of the bond markets must therefore use at least some elements of the matrix system to price the thousands of issues that trade only several times a year. Matrix pricing can have one of the same drawbacks that broker quotes have. No bond trading house is strong in all kinds of bonds. Thus, valuations based on input from just one source, such as the Merrill Lynch or Kuhn Loeb matrices, will be only as good as the level of understanding and trading ability of the firm in that kind of bond. The UBAS system described earlier would have surmounted this problem by having multiple trader valuations and by using acknowledged leaders in various segments of the bond market as the sources of such valuations.

To illustrate the basic concept of matrix pricing, assume that only one kind of bond were available, and that those bonds were of the same rating, same maturity, and the same other features except the coupon. One could then set up a scale as illustrated in figure 1, indicating the relationship between the coupon on the bond and its price at any given time. The price, of course, would depend on current interest rates. If a 7%, 20-year bond were priced at par, then a higher-coupon bond would have a higher price, and a lower-coupon bond would have a lower price. One could develop a range of prices for coupons between 3% and 10%. Using this scale, one could easily price a bond with a coupon of 7.35% without having a direct broker quote. The example can be expanded by allowing another bond variable in the picture. Allowing bonds to have different maturities, a second scale can be created at right angles to the first scale of coupons, which would indicate maturities of bonds from one to 30 years. Using these axes, a line could be drawn indicating the relationship of these two factors to a par bond (figure 2). This line would be the market yield curve at that time.

Price	Coupon
121	10%
116	9%
109	8%
100	7%
90	6%
81	5%
73	4%
66	3%

Figure 1

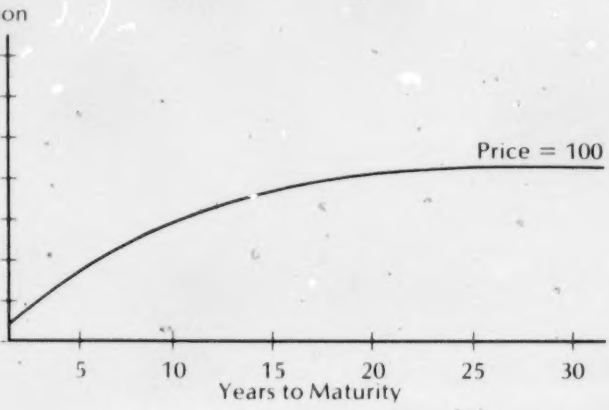

Figure 2

Having established a base point, the par value curve, one can look at a section of the graph, say, in the area of 7% coupons and 20-year maturity, and indicate the relative value of an additional five basis points of coupon. This might be worth an extra four basis points in the yield to maturity of the bond. If one were to move another five coupon basis points higher, a yield to maturity on that bond could be calculated, say, another four basis points higher. This could be continued for all coupons within 25 basis points of 7%. Following the same method, if one held the coupon constant and moved by increments of one year from a maturity of 20 years, one could indicate the relative value of a 7% bond with a 21-year maturity as being three basis points higher. If one moves in the other direction and there is a maturity of 19 years, one might find that the yield to maturity would be four points lower.

Moving in this fashion, all of the maturities could be filled out from 15 to 25 years. With two complete scales now, lines are drawn representing bonds of equal value (figure 3). It may be noted that this graph resembles a topographical map. Instead of the lines representing altitude, the lines represent the value of a bond. Unlike a map, however, which may show where the altitude reaches one height and where it reaches another height without showing what the intervening terrain looks like, in the mapping of bond prices it can be assumed that the market is reasonably efficient and that prices change smoothly between the various lines.

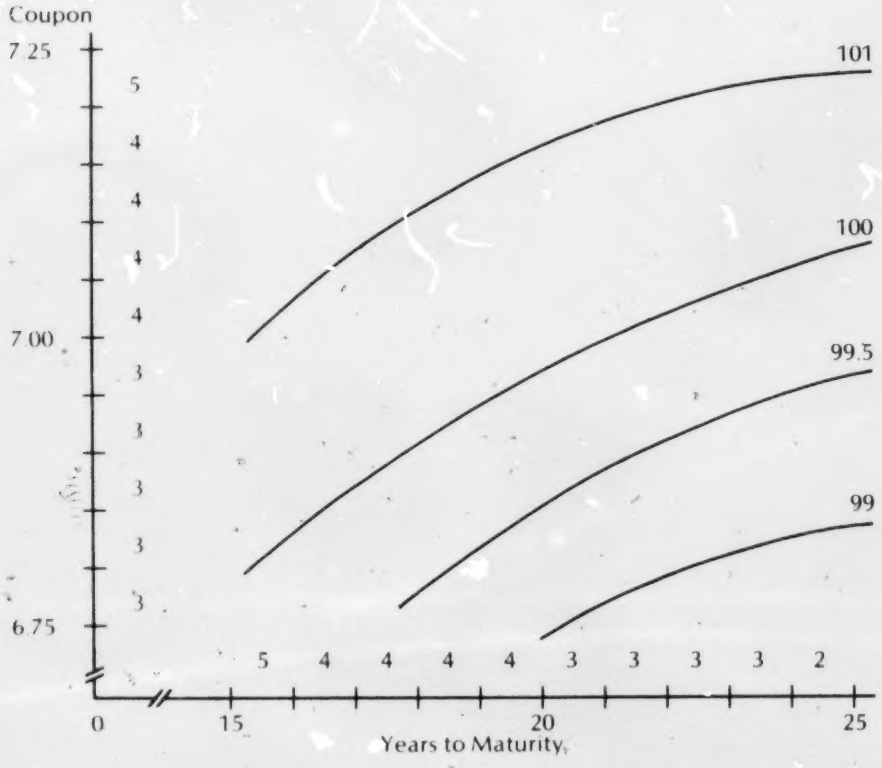

Figure 3

If one continues indicating increments along both axes, not only for the 15- to 25-year range, but also for short-term bonds from one to five years, intermediate-term bonds from five to 15 years, and very-long-term bonds from 25 to 40 years, as well as all the various coupon groups, one would have a complete mapping for all bonds with just two variables, maturity and coupon. Thus, without having specified a price for all the possible bonds represented by this graph (there are an infinite number of such points), one can nevertheless determine what its price should be from this two-dimensional graph or matrix. If the example were expanded again to include a

third variable such as bond rating, one could indicate for each area what the relative value of a higher or lower rating was. If one were now to graph the par bond line, it would actually be a plane, as shown in figure 4. Slightly above this plane exists another plane, which would be the set of all bonds with a price of 101. This plane would have the same general shape as the par bond plane, but need not be parallel, since an extra year to maturity at year 40 does not change the yield to maturity of a bond very much, but an extra year to maturity at year five does have substantial impact. Keeping track of bond prices in the three-dimensional example requires either an extremely good draftsman or a computer to track all the relative scales. If the example were expanded to a fourth variable, it would become impossible to

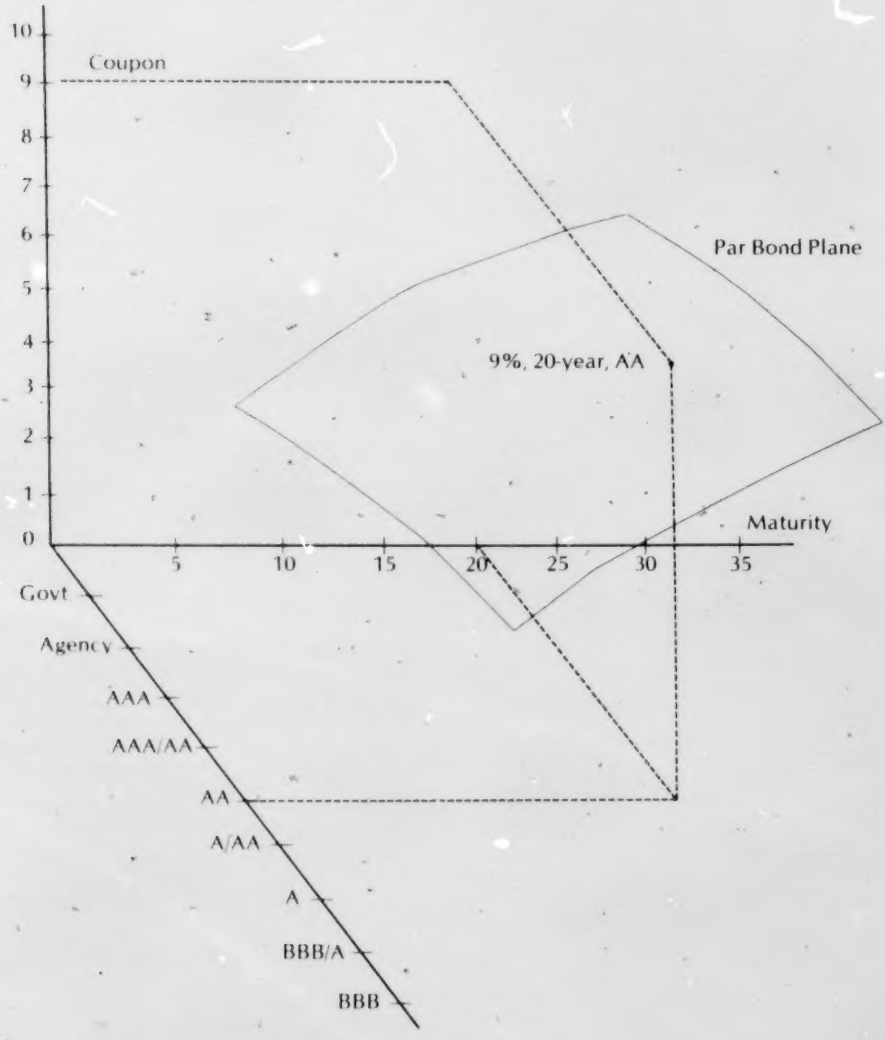

Figure 4

graph an illustration, but a computer could keep track of all relative values with matrices.

A matrix is simply a mathematical substitute for a multidimensional graph, with any number of variables to be tracked. Depending on the desired level of sophistication in pricing, scales could be created for any of the following variables: total size of a particular issue (i.e., its liquidity), refunding date, sinking fund, seniority of the debt, and several others. Of course, the more variables, the more time it takes to fully describe the entire universe of bonds. Short cuts can be taken with some of these less significant variables, such as total size of the issue. One could simply adjust each bond's yield to maturity, such that issues with more than 100 million outstanding would sell for five basis points lower, issues with 50 to 100 million outstanding would sell at the value indicated, issues with 20 to 50 million outstanding would sell for five basis points higher, and issues with 10 to 20 million outstanding would sell ten basis points higher. While this approach is less exact, it significantly reduces the total work necessary to price the entire matrix. This short cut makes a linear adjustment for the liquidity of an issue regardless of its maturity, rating, or coupon when it is unlikely that the difference between a low- and high-liquidity AAA bond would be exactly the difference between a low- and high-liquidity BBB bond. Thus, through a combination of relative value scales in the matrix and a number of linear adjustments for minor features of a bond, one can take any bond with its complete description, and price it in the matrix. First one finds its position in the multidimensional example, reads off its yield to maturity, makes any necessary adjustments for specific but less important features of the bond, and then calculates the value of the bond from its adjusted yield to maturity. Generally, matrix pricing systems now available use the three variables, with adjustment factors for other features. Theoretically, with computers it would be possible to create a five- or six-dimensional matrix that would be a more precise model of bond prices.

Matrices are created in one of two ways. Two bond pricing services, Interactive Data Services, Inc. (IDSI) and Digital Information Corporation (DIC), use a method that calls for the input of many accurate valuations from other sources, either other pricing services or trader quotes, and the computer generates the relative value of intervals of the various scales. For instance, the computer would take a price of 105½ for an AAA issue like Southwestern Bell Telephone 9¼% of 2015 and compare it with a price of 106½ for another solid AAA 9¼% issue with a maturity of 2000. The yield to maturity of the first issue is 8.75, while the second is 8.60. Thus, there is a 15-basis-point higher yield to maturity for the issue with 15 years longer to maturity. The computer would calculate a line connecting the two bonds with a slope of about +1 basis point per year. By comparing different sets of bond prices, the computer can generate all scales needed to price any other bond.

The second method, used by Merrill Lynch and Kuhn Loeb, calls for the direct input of the scales by the person controlling the matrix. A central issue is chosen, usually a very liquid one whose price can be readily and accurately observed. The trader then creates the scales by moving in increments away from this

issue and deciding by how many basis points such a move would change the yield to maturity. Since the trader will have an accurate price for many similar issues, he can check to see if the matrix would correctly price these issues. The Merrill Lynch matrices have small enough divisions so that all issues falling in that range are priced at the center issue's yield to maturity. No interpolation is used on any of the scales; rather, adjustment factors are added for each individual bond. Once a matrix has been priced and checked, the trader need only change the increments when a relative shift takes place in market. If the whole market moves uniformly higher, then only the yield to maturity of the center or key issue need be changed, since all the other issues are valued from it. Only if the spread between low AAA and high AAA bonds changes will some of the scale increments or adjustment factors have to be changed.

The Problem of Bond Valuation for Educational Institutions

BEFORE EXAMINING the individual pricing services, one should attempt to identify those features that are important to educational institutions. The NACUBO survey requests quarterly market values of all assets, but accepts annual valuations. Most larger institutions surveyed price their assets on a monthly basis. The first requirement for a generally accepted pricing service is that prices be available monthly. Thus, the daily pricing capabilities of Telstat and Merrill Lynch are unimportant to most educational institutions. This particular feature of pricing services is generally geared to large mutual funds and bond funds that must compute net asset values for trading purposes on a daily basis. Both of these services also make their prices available within hours of the market close each day to satisfy these mutual funds. Such promptness is also unimportant for educational institutions. In general, a one- to three-day lag after the end of the month is considered acceptable, with larger institutions needing prices in two days or less and smaller ones in three days or more.

Educational institutions as a whole should consider the following features important when considering a bond-pricing service. First, accuracy and consistency of the prices. Do the bond valuations given by the service satisfy both the internal and external participants of bond portfolio management? Second, cost. Is the cash or brokerage commission (hard or soft dollar) cost of a particular pricing service excessive for the portfolio of an individual institution? Third, format. Does the service make the prices available in a format (tape, punch cards, hard copy) convenient for the institution? Fourth, universe of issues. Does the pricing service cover the issues the institution owns or is interested in? Specific areas might be corporates and governments, municipals, or private placements. Fifth, issue size. For what number of bonds does the pricing service give a price, and is this the same size as the institutional holding involved? Last, bid-ask. Which prices does the service give: the bid, the ask, the middle, or the last reported trade price?

For all the features stated above, each educational institution probably has its own particular point of view. While this may vary according to the size of the institution or other variables, the appropriate pricing service depends on the institution itself and how it perceives its requirements in the categories listed above.

The first category, accuracy, has received the most attention from potential users. All pricing services strive for accuracy; however, none has reached the point where it has been acclaimed accurate by other than a small group of its own backers. This is largely due to the nature of dealer markets and lack of centralized quoting of trade prices. While one service could report the price of an actual trade at the market close, another service could report a different price of another actual trade at the market close; both are accurate in the sense that they are real trade prices. Thus, accuracy in bond pricing does not exist in the same sense as it does with stock pricing, where a centralized market allows only one last trade. It should be noted that educational institutions usually do not need the pinpoint accuracy that many organizations like mutual funds do. This is not to say that inaccurate prices are acceptable. Variances of 3% to 5% in reported prices of publicly traded corporate debt are not acceptable, and would obviously greatly change unit share values and performance features based on such prices. While any comparison of two different pricing services will show an individual price variance as great as 3% to 5%, the number of such issues is very small (one or two per hundred) and the relative impact for an entire portfolio is minor. As will be explained later, some services do have bias introduced into their pricing. However, more than a 1% net discrepancy between any two pricing services for a portfolio of more than ten issues would be extremely rare.

The format of price availability is an important variable to educational institutions. Two basic formats are available: computerized and manual. The majority of the money management industry is now computerized, meaning that institutions would choose a pricing service with prices available in a computerized format: on magnetic tape or punch cards. A few large institutions and most small portfolios, individual and institutional, are still priced manually, issue by issue, either by hard copy or telephone, and the total portfolio value is figured by hand. The existing format of educational endowments accounting is split between these two methods. There are many small endowments that still price by hand, and this seems quite reasonable when the total size of the bond portfolio, usually less than 15 or 20 issues, is considered; however, most large institutions with portfolios of 50 or more holdings receive their prices in some computerized form. Asking for, receiving, and inputting this greater number of issues manually can be time-consuming, and the computer is cost-effective here. So the question does not break down into what format is available from the pricing services, but, most important, what format is acceptable to the institution. Many smaller institutions are not computerized at all and cannot process computerized tapes or cards; thus, a hard-copy format is necessary. However, internal accounting has progressed to where all but the very smallest institutions may be considering some form of computerization of procedures. So even institutions with 10 or 15 bond holdings may be in a position to consider computerized bond pricing services.

The issue of cost is often less important to educational institutions because all the pricing services have relatively low cost. For institutions with less than 50 issues to be priced per month, total hard-dollar (cash) cost of the most expensive service is $750 per year. For large institutions that might require a master tape of

all closing prices, the soft-dollar (brokerage commissions) cost for this service may run as high as $10,000 a year, but this would represent only a small percentage of total commission dollars for such an institution. Thus, even this most expensive service would be affordable. This is not to say that the cost of pricing services is irrelevant. Due to differing views of the purpose of pricing services, the structure of charges within the industry is very diverse. Thus, while one service might charge $500 for a particular product, another service might provide it without charge.

Although educational institutions are tax-exempt, this does not restrict their holdings of securities. Endowed institutions generally hold a great variety of types of bonds. Unlike a mutual fund or individual investor who holds one or another type of security exclusively, endowments are long-term and large enough to own private placements, liquid enough to own corporates, risk-averse enough to own governments, and provide financial functions for others that make it advantageous for them to hold tax-exempts. Few pricing services are capable of handling all of these areas. Each educational institution should examine both its present portfolio and its possible future investments to determine the areas in which it requires prices. It is possible to use more than one pricing service to cover all the areas; however, the inconvenience involved must make it an inferior strategy to receiving prices from a single source.

The two remaining issues in bond pricing are less important than those just discussed, but usually receive much attention. The first is the question of what price to use for a bond: the bid price, ask price, last trade price, an average of the prices, etc. Use of the last trade price brings up the problem of how recent was that trade. If it is more than three or four days old, then nearly any other current valuation would be better. Unfortunately, some states have long required the use of last trade price for valuation of assets of state-licensed institutions such as banks. Many valuation services have deferred to this law and will show the last trade price if it is reasonably current. Since most bonds are unlisted, this law affects only a small portion of the market. Nevertheless, it is an anachronism for educational institutions, since both broker quotes and matrix pricing are better than a several-day-old trade of two or three bonds on the Big Board.

Some institutions argue that an average of bid and asked prices represents the most reasonable price at which a trade could actually be accomplished. This is probably true, in that this is the most likely value for the next trade, i.e., the value the portfolio could realize if it were the first one to enter a stable bond market the next day with a sell order. All pricing services offer at least bid quotations on bond prices. However, just because prices besides the bid price are offered does not mean that institutions should use them. Almost all feel much safer being conservative in using the bid price rather than the last trade or offer price. This is the source of the convention of using the bid price; more by its almost universal acceptance than by any other logical argument, bid pricing should be adopted to maintain comparability with other funds being measured. Performance measurement purposes would be adequately served so long as one reasonable price for a bond was used consistently. Since all valuation services offer at least a bid valuation, the decision to use the bid side does not exclude any services from consideration.

However, for institutions that use services offering more than one price, it is important to use the bid price to maintain comparability.

The last issue to be considered here is that of position size. Educational institutions own a large range of position sizes, from $10,000 per position to others with a minimum of $1 million in each position and sometimes as much as $5 million. As explained earlier, relevant pricing for bonds must consider the number of bonds offered. An institution with ten bonds to sell would receive a lower price than one with 1,000 bonds to sell. Whether this difference in size of position is relevant to bond valuation is controversial. Valuation services connected with a trading house generally give valuations for an average institutional-size trade at their house, since it is usually these institutions that use the pricing service. Independent pricing services are largely unaffected by this issue because their prices, used by various kinds of portfolios, large and small, come from sources based on many different-sized blocks of bonds. Nevertheless, pricing services usually try to indicate the size of bond holdings to which the prices apply. Educational institutions should be aware of this size so they understand any bias in valuations due to the difference of size of position.

The issues covered are the most relevant for educational institutions considering bond pricing systems, and are placed in their order of importance. If a pricing service is not accurate, educational institutions should not consider it. However, if a service does not price for the same size of position as the institution holds, this should not automatically disqualify it. If the user understands the relative drawbacks of each service and its policies concerning the issues outlined, then if a poor match between user and service occurs on a less important point such as size of position, this can be weighed against more important points that may still carry the decision in favor of that system.

Moody's and Standard & Poor's

THESE TWO SERVICES are the best-known evaluations of debt issues in the United States. Each makes available various publications primarily concerned with the rating and coverage of publicly traded bonds. Both make available monthly a complete list of all bonds they follow, including such other information as industry, payment dates, refunding dates, and high, low, and close valuation data. Moody's "Bond Record" obtains their valuation data from market maker quote sheets and direct inquiry. The S & P "Bond Guide" uses these sources plus a matrix to price utility issues, which are the most homogeneous group of bonds and thus lend themselves quite well to matrix valuation. Since neither monthly publication is available before the 10th of the new month, they have time to wait for published market maker quotation sheets to be distributed, usually a day or two after the end of the month. These sheets are published by several dozen trading firms and cover a wide range of issues. The smaller houses may show quotations of only 75 to 100 issues, whereas the larger and well-known houses may carry as many as 600 quotations for bonds in their specialty areas. The largest published quotation sheet is prepared by the National Quotation Bureau, which distributes daily and monthly lists giving quotes on most liquid issues as well as many inactive ones. Approximately 3,000 issues are covered by trader quotations submitted to this service. While not generally available to the public, the National Quotation Bureau is the source for many of the quotes of both the S & P and Moody's services. The remaining 2,000 valuations are obtained from exchange closing prices and by direct telephone inquiries. Also included are ratings and approximate yield to maturity levels of railroad equipment trusts and municipals.

Both services are available by direct subscription for $75 to $100 a year. However, Standard & Poor's service is purchased by Merrill Lynch among others, and these bond guides are given without charge to selected customers. Most Merrill brokers can provide information on availability. While Moody's has no such arrangement, many educational institutions receive this service in their library, and it is often available at public or county libraries or other nearby financial institutions. So either one of these services can probably be obtained at no additional out-of-pocket cost.

Due to the lag between the end of the month and availability of these bond valuations, institutions with any monthly accounting timetable for valuation of the

endowment will be unable to use this service. But for institutions that calculate endowment values for external performance measurement only, these services are recommended because of their accuracy and broad coverage of publicly traded issues.

Bond Indices

Both S & P and Moody's publish bond yield indices in exactly the same format. Individual indices are available by sector (utility, industrial, railroad, or corporate) and by rating (AAA, AA, A, BBB) with the exception of the AAA railroads index, which has been discontinued. Each category, such as AA utilities, has six to ten bonds included. Moody's also carries two finance company indices. While all bonds are long term, and at this writing the closest single maturity is 15 years, the average maturity of the categories runs from 19 years to 34 years. When a bond in a category approaches 10 years to maturity, it is removed from the index and a similar bond with about the same yield to maturity, but with 20 years or more to maturity, is substituted. So while the rating of the securities is controlled and substitutions do not affect the yield to maturity of the category, the average maturities can vary quite a bit and the categories themselves are not very comprehensive with less than 10 issues. Also, the indices are constructed on a straight arithmetic average of the yield to maturities rather than with any market weighting.

So while these indices are passable general indicators of the yield to maturity level of various sections of the market, they are not well enough constructed to be the basis of any relative performance comparisons.

Salomon Brothers

SALOMON BROTHERS is probably the largest bond trading house in the world, with the most comprehensive organization of bond traders. From this base, they have an advantage in bond valuations; however, this superior potential is not fully realized due to the low importance they place on their bond pricing service. Their main business is creating a marketplace and the buying and selling of bonds. The valuation of these assets to outside institutions is considered such a minor detail that Salomon Brothers expenses the entire cost of the program, so it costs nothing to outside users. While no cost is a very strong plus for this service, several drawbacks make it less attractive for certain institutions. First, prices are not available in machine-readable form. Salomon Brothers is slow in making the prices available, and they cannot price private placements or other issues out of their universe except on a month-by-month individual basis.

The Salomon Brothers pricing system is entirely trader based. Each of the almost 4,000 issues is priced monthly by one of about 60 traders. These issues represent about 98% of outstanding, publicly traded corporate debt. They are broken down into various areas according to maturity, coupon, and issuer; then each type is assigned to a trading desk responsible for the pricing of all the issues in that group. For example, there might be three or four traders at the desk that trades and values long-term, high-coupon utility issues. Since each trader values an average of 70 issues, which takes an hour or more, the traders will begin pricing the less liquid bonds two or three days before the end of the month. The larger, more widely held issues are priced on the last day of the month, insuring very accurate pricing for this group. If no major move has been made in interest rates, the traders would then turn in all their prices on the first working day of the new month. If a major move in interest rates has occurred, then the traders must reprice the smaller issues at more current levels. This generally takes an extra 24 hours, and can mean four or five days instead of the three normally required to get the entire list of valuations out to the regional offices. Using the actual traders in a particular class of bonds and the actual issues traded means that much of Salomon Brothers' system is essentially trade validated. A trader will simply use the last price at which he or an associate on the same desk traded that bond that day.

Since Salomon Brothers is largely an institutional trading house, its pricing is on the bid side for institutional-size blocks of $1 million. Salomon will also price private placements or any bond at any time upon request. In general, this service is provided only to institutions that do significant business with Salomon. Many

bond managers with several hundred million under management have Salomon give them prices the first day of the new month on 100 or more issues.

After all the traders have submitted their prices, the issues are typed into a computer, which then prints multiple copies of the list. It should be noted that the computer does nothing except check for typing errors and produce a large number of copies. No statistical review is made of the traders' prices, nor is a matrix used for pricing any of the issues. After hard-copy distribution, the prices are also entered into the internal Salomon Brothers computer system, and are available for direct display to any trader if requested. This service is generally available about the fifth day of each new month. It should be noted that even without computer support, no bond manager interviewed by this writer expressed any dissatisfaction with prices from Salomon Brothers, even on less liquid issues. This reputation can only be attributed to Salomon's being by far the largest trader of bonds in the United States, and to continued diligence on the part of the traders in delivering a good product.

Long-Term, High-Grade Bond Index

After the prices for the 4,000 issues have been submitted, a separate department of Salomon Brothers responsible for their long-term bond index takes the offer prices on the 175 issues included in the index and generates a new index value. It is unusual that offer, or ask, prices are used in this index, but it was initiated this way in 1969, and, rather than cause a discontinuity, remains unchanged. It should be noted that while the price level of the index is changed by this convention, its month-to-month performance is not. The issues are grouped into 51 market sectors, and a straight arithmetic average of the yield to maturities within each sector (usually three or four issues) is made. Then each sector's yield to maturity is multiplied by the entire sector's par value weighting in the total outstanding corporate debt. This generates a reasonable proxy for the entire high-grade, long-term bond market.

The index is split almost 50-50 between AAA and AA issues, with utility issues composing 68% of the index and industrial issues 32%. The average maturity is 25 years, the closest being 11 years. Monthly yield is calculated essentially on a steady flow basis with 1/12 of all bond coupons being paid each month. While not quite representative, this accrual method is a reasonable substitute when one considers the additional amount of information that would have to be processed if interest were to be credited when paid (which would be the completely accurate way of determining the yield component). As with most bond indices, there are still unresolved problems when bonds reach the minimum maturity and when new issues are brought into the index. Unfortunately, Salomon has chosen to weight the index by par value instead of market value, which tends to overweight the more volatile performance of deep-discount bonds. About 30% (par value) of the issues in the index have coupons less than 6⅞%, and almost 15% have coupons less than 4⅞%, so this overweighting is fairly significant. The index issues have been carefully selected and the relative par value weightings of various sections of the bond market recently updated, so that this index is a very good general indicator. But due to the problems mentioned above, it is only a fair performance proxy for the long-term, high-grade bond market. Specific performance comparisons would be better made with the more directed market value weighted indices available from other services.

Kuhn Loeb

KUHN LOEB IS ANOTHER of the largest and most respected bond trading houses on Wall Street. It does a majority of its business in trading bonds—mostly with large institutions. Kuhn Loeb also performs other financial services, including performance measurement and asset monitoring. It is in conjunction with these services that its bond pricing service is offered. It should be stated that Kuhn Loeb does not make available its pricing system as an independent service, and does not create a tape or master list for public distribution of the issues in its universe. This service is, however, of interest both for the methodology employed in creating a matrix from which prices are drawn and for the numerous bond performance indices created from this monthly effort.

About 5,500 issues are priced every month by the Kuhn Loeb matrix. This includes issues of all maturities down to one year and of all ratings down to D. The pricing system is basically a matrix, although the larger, more liquid issues are priced directly by brokers. Each month over 500 quotes, largely devoted to top-quality bonds, AAA to BBB, are taken from five traders in various bond areas at Kuhn Loeb. These quotes are used as the key issues for construction of the 27 matrices involved in the pricing service. After gathering the quotes, traders do not have any further part in this system. At this stage the adjustment of the matrices is left solely to the head of the Kuhn Loeb pricing service. By following a somewhat trial-and-error method, the relative scales of the matrix are adjusted until everything fits reasonably well.

It should be noted that Kuhn Loeb does not strive for high precision in its bond pricing service; acceptable accuracy is within one percent. In this kind of system getting this close is largely a function of the person who controls the matrices. Because he is not a bond trader by profession, but spends most of his time on financial services, the prices from this bond pricing matrix most likely can be said to be inferior to those from a trader-controlled matrix or a comprehensive system of direct quotes. To the extent that direct quotes are used for the larger issues in the Kuhn Loeb index, its pricing service is quite accurate and discrepancies in smaller issues would probably not be significant in any but lowest-quality bond portfolios.

The Kuhn Loeb prices are generally available by the third trading day of each new month. In addition to the 5,500 corporate, utility, and financial issues priced, all government issues are included by direct broker quote or trade, since all these trades are reported. Prices generated are for the bid side of the market and, due to Kuhn Loeb's large institutional orientation, generally for $1 million in bonds. The system includes no municipals, railroad equipments, or private placements. As indicated before, the listing of all prices is available only for internal Kuhn Loeb use.

Bond Performance Indices

Kuhn Loeb's bond pricing system is the source of the most extensive set of bond performance indices available to date. Of the 5,500 issues priced, over 4,000 are included in the Kuhn Loeb bond performance index. This index, available back to July 1973, is broken down into sub-indices based on rating quality and type of issuer. The issues included cover about 99% of the publicly traded nonconvertible outstanding debt in the United States. All issues are market-weighted so that the indices show what the performance of the entire market has actually been, much like the Standard & Poor's 500 average indicates what the real broad performance of the largest capitalization stocks has been.

Kuhn Loeb recently released a new series of sub-indices. Indices are now available under the following headings: (1) maturity—either long, intermediate or short; (2) rating of issuer—AAA, AA or A, BBB, and lower; and (3) type of issuer—industrial, utility, or financial corporation. All the sub-indices, like the main index, are based on total return and are market-weighted. The point of market-weighting issues is to represent what the average portfolio of all investors has done. Since all investors combined must own all the outstanding debt, the issues with larger amounts outstanding will affect the total return of more investors than will smaller issues. By combining 4,000 of the largest publicly traded corporate debt instruments, Kuhn Loeb has provided a very good proxy of what the average investor will have achieved on a pre-tax, total return basis. The Kuhn Loeb sub-indices should be thought of in much the same way that equity managers break down the S & P into various categories. If large amounts of debt are held in one particular area or in one particular quality rating, then total performance will be affected not only by what all bonds do but what bonds of that particular type do. In addition, many bond managers are restricted as to the kind of security they can hold. As a result, it is inappropriate to measure their performance against an index that includes all types of bonds, many of which they could not hold. By having sub-indices, universes can be constructed for specifically grouped subsets of the main bond trading universe.

In summary, these indices are well constructed and appropriate for comparative performance measurement. While some of the underlying pricing may be somewhat inaccurate, especially for lower-rated issues, since far more effort is spent on the liquid, higher-quality issues, the indices are nevertheless a reasonably accurate representation of the total bond market.

Digital Information Corporation

DIGITAL INFORMATION CORPORATION (DIC) has developed a bond pricing system that attempts to solve the problem of unreported trade prices, which is the basic one in the bond market. DIC subscribes to all major bond pricing services and creates a matrix from the prices received. The law of large numbers is invoked here to obtain the most accurate pricing for all issues. Next, by using trades reported by their own clients, DIC attempts to trade-validate certain entries in their matrix. This methodology is unique among operational bond pricing systems, and is a step towards the theoretically optimum pricing system explained earlier in the UBAS proposal. Just as with UBAS, DIC tries to stress uniformity and consistency throughout the bond spectrum, rather than be very accurate for some issues and much less so for others.

DIC follows more than 25,000 taxable public and private issues, and has over 250 portfolios subscribing to its system. This number of portfolios does not, however, allow validation of more than a small percentage of the total number of traded issues. If the number of portfolios followed were to be expanded significantly, then a large number of issues could be trade-validated on a daily basis, and the system would begin to resemble UBAS. So, while this approach is more difficult and expensive, the first steps toward an optimal system are already being taken on a private basis, independent of any bond managers or bond traders.

DIC is an independent computer information system that sells many financial products to institutions. Its bond pricing system is not available separately and has been included here only because of the theoretical and operational significance of the methodology. DIC sells a total performance measurement package, including its own or any other bond pricing system for $3,500 per year hard dollars (cash), or about $8,000 per year soft dollars (brokerage commissions). For the ten or fifteen largest educational institutions likely to spend that amount anyway, DIC is a good service offering a full range of pricing and performance packages, which are well worth considering.

Interactive Data Services, Inc.

INTERACTIVE DATA SERVICES, INC. (IDSI) is a combination of the older dealer quote method and newer matrix methodology. In business since 1958, IDSI has found the valuation market growing so fast that it could not stay with its original dealer quote system. IDSI is a subsidiary of Interactive Data Corporation, which bought the pricing and data section of Standard & Poor's (the S & P tapes); this was the origin of IDSI. More recently, Chase Manhattan Bank bought IDC, but the pricing service functions independently of the bank. Because of its long history and the use of matrix, IDSI can give valuations for over 15,000 corporate debt issues on a weekly or monthly basis. IDSI also distributes pricing data on some 15,000 additional securities, including all U.S. and Canadian stock exchanges as well as many foreign issues and dollar bonds. IDSI therefore gives broader coverage of issues than nearly any other service. As with all other major services, municipal issues are priced directly from a matrix. Over fifty different series of municipal bonds are input as the basis for this matrix, and IDSI has the exclusive services of Mr. Wilson White, well known in the industry for publishing White's tax-exempt bond market ratings. IDSI will add private placements and unpriced public issues to its universe to satisfy user needs.

IDSI uses direct trader quotes on well over 1,000 issues as the basis for its matrix. Using this many inputs allows a very price-sensitive matrix to be set up. Just as with the municipal's matrix, IDSI has tried to take extra steps to assure reasonable accuracy. Input prices are received from the National Quotation Bureau as well as from quote sheets from Salomon Brothers and First Boston. Direct telephone inquiries to other traders are also used. The matrix is then constructed by the computer and the remaining issues are valued. Some statistical variance checks are made to eliminate any spurious major valuation changes.

A customer has a choice of which of the bid, ask, or mean prices he or she wants to receive. However, if a listed bond has a recent trade, that price is always quoted. Prices are available either by tape or, for customized portfolios where only a specific list of issues is being priced, by computer card, hard copy, or telephone if desired. IDSI does not, however, publish a complete hard-copy list of its prices and valuations.

Strictly for legal reasons, IDSI uses all current, last-trade prices for listed issues. As indicated earlier, this tends to bias the prices downward because of the small size of the trades. The remainder of the issues are valued for round lots of $100,000 to $250,000.

IDSI is the most expensive of the full-scale automated valuation services. A monthly tape of their 32,000 securities (stocks, bonds, and other) costs $5,300 a year. However, an educational institution discount of 25% is available, and this drops the price to a more competitive $4,000. Commission, or soft-dollar, arrangements must be made independently with a broker. Since some services will convert soft dollars to hard in the ratio of 3 to 1, the soft-dollar cost of IDSI comes out to about $12,000. Individual quotes on tape or card cost 25¢ per quote while hard copy is 50¢ per quote. Extensions and totals for institutions wishing to keep a file of all their holdings in the IDSI computer are also 50¢ per quote, with a minimum of about $400 per year.

While IDSI is slightly more expensive, it carries more issues than any of the other services. If this is an important factor for an institution that is fully computerized and able to use all these valuations, then IDSI's service is recommended. Valuations are good but suffer a little, as do most other services, from the legal requirements of carrying listed bonds at last trade prices.

Telstat

TELSTAT IS THE OLDEST computerized bond pricing service in the United States. It is purely a service bureau which gathers information such as bond prices, stock prices, and other asset valuations and disseminates this information throughout the world. As a service bureau, Telstat must rely on bond prices gathered from many different sources, rather than from its own traders or personnel. Telstat prices over 10,000 corporate issues, as well as governments, railroad equipments, and private placements. The latter two categories are priced using a matrix rather than by direct dealer quote because of the vast number of outstanding issues. Additionally, Telstat sells tapes of asset valuations on all North American stock exchanges, including Canada, many foreign equity and bond issues, all Chicago Board Options Exchange listed options, many over-the-counter issues including preferred stocks, equipment trusts, mutual funds, banks, and insurance, as well as other selected issues such as dollar bonds, U.S. savings bonds, and market indices.

Telstat is almost as comprehensive as any asset pricing service available, and superior to any other service in the statistical review of prices. Computerized checks of price variance for many issues are made daily. In addition, tolerance tests are set up, based on key market indicators, so that issues whose prices have moved significantly away from the market or sector indicator are repriced to assure accuracy. This kind of check is necessary for Telstat because it depends on outside sources for specific bond valuation information. If a trader gives a bad bond price, Telstat cannot detect this except through this series of sophisticated edits.

Telstat prices its bonds in the following manner: For each bond, three prices are shown. Telstat indicates that they should be viewed as a low, medium, and high price, or perhaps a conservative, average, and optimistic price. Many customers incorrectly assume that the three prices correspond to bid, ask, and last-trade prices. In reality, for listed issues that have traded that day, they are the low, high, and close trades. For all other bonds the three values are a conservative value, an optimistic value, and an arithmetic average of these two values. Thus, the third value is not the last trade price for many issues. For listed issues that have not traded that day, often the two conservative and optimistic prices will be the actual current exchange bid and ask prices. Telstat also carries a fourth price

for such issues, the last trade price no matter how old, for institutions that must use it.

While the terms Telstat applies to its values are different, this system is just as good as any other for pricing bonds. Indeed, for some institutions where more optimistic bond prices are desirable, Telstat's system has advantages (because it offers a higher valuation). Telstat recommends that its customers use its average price, in part a compromise because Telstat has so many different kinds of users. However, for educational and most ERISA institutions, the more conservative price should be used to remain consistent with most bond managers and pricing services that price on the lower, or bid side, of the market.

Telstat has contractual agreements with over 100 trading firms to provide current market valuations. It uses market maker quote sheets if available, but must rely on direct telephone quotes for most unlisted bonds. Telstat tries to use traders with particular expertise in the kinds of bonds being priced. For instance, the two best-known traders for Canadian issues, Dominian Securities and Wood Gundy, are most often the sources of the Canadian bond prices. For other foreign bonds, White Weld and Kuhn Loeb are generally the source. U.S. government and agency bonds are either quoted directly from the Federal Reserve or from Salomon Brothers. In obtaining these quotes, Telstat asks each broker for three prices: low, average, and high. It should be noted, however, that a characteristic holding lot is not specified, contrary to Salomon, Merrill Lynch, or Kuhn Loeb, which state a specific trading size intended for all prices in the service.

Telstat does not indicate such a size for two reasons. First, it does not wish the dealer quote to be a function of the dealer's inventory. If he happens to have a great number of bonds of that issue, he may be likely to push that price upwards, in part because he has collected a large position and actually thinks the bond is worth a higher price. On the other hand, some argue that a large position, perhaps too large, will force a dealer to lower his quote. By asking for a price without stating a size, Telstat hopes to avoid problems with this bias. The second reason for not specifying size of holding is that Telstat has many different users and for some, a quote based on a very small number of bonds would be more appropriate. This is especially true in bank trust departments, which rely heavily on automated pricing services such as Telstat, and where the average bond holding is not $250,000 to $500,000, but $10,000 to $50,000.

The use of exchange closing trades for all listed bonds also reinforces the tendency of Telstat to price for a smaller number of bonds, since all listed exchange trading of bonds is for small lots. Thus, both in dealer quotes and Big Board prices, Telstat prices for a smaller amount of bonds than any of the other major pricing services. This bias towards smaller bond lot sizes is perhaps an advantage to educational institutions where bond holdings do not run over $100,000 per issue. While Telstat and some of its clients have examined Big Board prices versus trader quotes for the same issues and found very little difference, bond managers almost universally indicate that these quotes nevertheless have some objectionable bias. Around midyear 1977, Telstat intends to introduce an option that will give mathematically computed round-lot bid and ask valuations for all listed bonds

instead of the high and low trade prices. For institutions with round-lot holdings, use of this option should remove most of the objectionable downward bias associated with Big Board trade prices. Another problem is that the user does not know whether the price of a particular bond was obtained from an exchange or a trader. Thus, two similar bonds, one listed and one unlisted, may have different prices solely because one was quoted by a trader at a price for a round lot, and another was priced from an exchange on the trade of one bond. While the downward bias of exchange prices does exist, it is not as large as the 2% or 3% that some users indicate, but is nearer 1%, certainly a reasonable level of tolerance for something as subjective as a bond price. It should be noted that many ERISA-conscious institutions and some state laws require the use of the last trade price where one exists, regardless of the volume of the trade. Thus, while Telstat prices are sometimes more legally defensible, they can vary from a consensus trader price for a round lot by about 1% on the down side.

As is obvious from this explanation, the Telstat method is more expensive and more laborious than other pricing services. However, the large number of users allows a lower unit cost than most other services. Telstat makes its bond prices available in any format: card, tape, hard copy, and computer forms are available for all its pricing products. The hard copy of the entire universe of bonds is $750 a year and is available on the first day of the new month. On a per-quote basis for either corporates or municipals, Telstat charges 25¢ in hard dollars. Users may make arrangements with brokerage houses to pay with soft dollars. The conversion ratio generally is about three to one, so the soft-dollar cost is about 75¢ per quote. Telstat has a minimum charge of around $500 a year.

Purchase of the entire Telstat universe on tape is less expensive than other services because Telstat charges users only for the number of bond issues they own. Thus, if the user values only 200 bond issues per month, he pays only for those issues, but they can be any 200 issues, since the entire bond valuation tape is provided. Assuming the user prices 200 or 300 bond securities each month, the cost of the entire Telstat tape would be less than $2,500 hard dollars; soft-dollar conversion must be done through an independent broker. For institutions not wishing to carry their portfolio internally, Telstat will custom-price a user-maintained securities file with extensions and totals for 35¢ per quote. Individual quotes delivered to the user are 25¢.

Thus, while Telstat has a problem with listed bond prices, its lower cost to large institutions that use tape input, as well as its speedy service to medium-size customers that use hard copy, makes it a recommended service for institutions considering either hard copy or magnetic tape service.

Dow Jones 20 Bonds Index

As part of the Telstat bond pricing product, both the Moody's bond averages and the Dow Jones 20 bonds averages are provided. (The former were explained in the section on Moody's pricing service.) The Dow Jones 20 Bonds Index is similar to the Dow Jones Industrials; it is a select list of issues, a broad but general

indicator of the market. The 20 bonds index is a straight average of the last trade price of each of the 20 bonds, which are all listed.

Two problems are evident already: the last trade price may be several days old and represents an odd-lot trade, not what the more usual round lot would bring; also, when an issue matures, it is removed from the average, and a listed issue with more than 20 years to maturity is substituted. No attempt is made to control average rating or maturity, and while 10 of the issues are industrials and 10 are utilities, the bonds are not chosen with diversity in mind. The index presently has an average maturity of 18 years, with several issues maturing within five years. Issues range in rating from BBB (Con Edison 7.9% '01) to AAA (AT&T 8.80% '05).

Thus, the Dow Jones 20 Bonds Index is not much more than the average price of 10 industrial and 10 utility issues. It is certainly not a good indicator of the entire market, and is only a fair one of long-term industrial and utility issues.

Merrill Lynch

MERRILL LYNCH, the second largest bond trading house in the United States, has made a concerted corporate effort over the last five years to develop a superior bond-pricing product. The system presently includes about 8,000 corporate and many government issues, priced each day. In addition, over 500,000 municipal issues and all governments are priced weekly. All corporate pricing is done from over 20 different matrices; each is controlled by one of about 15 traders so that several traders have more than one matrix to price. Merrill Lynch has a large retail bond trading network and this manifests itself in a somewhat smaller average trade size used in the pricing. Traders price on the bid side of the market for an institutional round lot of bonds. After the trader has provided his daily matrix adjustment, the system is updated. There are internal checks for pricing, such as checking one day's prices against those of the previous day. Then a master list is made of all bonds priced, and the various formats required for Merrill Lynch clients are completed. This includes computer-to-computer transmission, access via terminal, punch cards, magnetic tapes, or hard copy of both the entire universe and of individual issues requested. The monthly hard copy of the entire universe is called the Merrill Lynch bond pricing book and costs $250 a year cash or $1,000 a year in commissions; however, it is not available until the fifth trading day after the close of the month. All other forms are available within 12 hours after the market closes for any form of delivery (mail, courier, air freight, or other), at the user's expense. Customized pricing costs 22¢ per quote hard dollars or 60¢ per quote soft dollars for up to 25,000 quotes, with a $350 minimum.

Use of the matrix pricing service has been both a boon and a major stumbling block for Merrill Lynch. While it provides good prices for thousands of issues daily, the use of this technique prices many bonds as a group. Thus, all industrial bonds with the same rating with coupons from 6½ to 6⅞ and a maturity of 1990-92 are priced at the same basic yield to maturity. The trader then adjusts individual bonds for specific features of the bond or just for the way it trades. At this stage Merrill Lynch is selling its trader's familiarity with that particular kind of bond and his willingness to take the time to make any indicated adjustment in the yield to maturity. Many bond managers feel that they cannot use prices where

they are not sure that all the individual features of an issue, particularly those they may have bought it for, are not examined. In its initial phases, Merrill Lynch's matrix had many problems. Even after several years of service, many Merrill customers indicated dissatisfaction with prices from a particular matrix or part of a matrix. This can be due to a trader's having a poor day or just that he missed a subtle shift in a part of the bond market.

Some of these problems were to be expected with such an innovative concept as matrix pricing, and most of them have been solved. There are, however, remaining difficulties with the data base. If an issue is incorrectly categorized as to its quality, maturity, sinking fund, or any other significant variable, then a matrix pricing system will always misprice it. This kind of problem was very evident in the early Merrill valuations, but now it has been reduced to an almost insignificant factor. Not so insignificant is the degeneration of the quality of valuation in low-grade issues. Because of the low liquidity and lack of trading in such issues, the Merrill system can only reflect somewhat wider variances from actual trade prices at other bond firms than high-grade issues, where Merrill Lynch is a major trader in the market and very aware of what is happening in those issues. Merrill has made a continuing effort to improve its services, is aware of these problems, and is trying to correct them. Its prices are generally very good, and the few problem areas are usually not significant.

Merrill's unique way of indicating bond valuations allows the user to choose Merrill valuations alone or the last trade price for listed issues. This satisfies those who must use last trade prices, yet leaves others such as educational institutions free to use the more uniform and unbiased Merrill valuation. It must be remembered that Merrill values bonds for $250,000 lots. If an institution owns only odd lots, then use of the listed price may be better than the Merrill valuation.

Since all Merrill valuations are done from the matrix, the prices generated are not rounded to 1/8th-point intervals. Prices such as 101.4472 disturb a few managers, but they should realize there is nothing unique about trading in 1/8th-point intervals. Also somewhat troubling on paper is the higher hard-dollar cost of the entire Merrill tape. However, almost all educational institutions that might consider purchasing the entire tape would want to pay with soft dollars. Merrill offers direct soft-dollar payment for the universe tape at a relatively low ratio of 2 to 1, so for all practical purposes, Merrill's valuation service cost is just about the same as IDSI's or Telstat's.

Merrill's bond pricing service has been accepted by many mutual funds and written into the prospectuses of some. This, with the increasing confidence of many other Merrill users, indicates growing acceptance of Merrill Lynch pricing, which, coupled with its extreme ease and competitive cost, makes it a recommended service for educational institutions owning more than 25 or 30 issues.

Merrill Lynch will also value portfolios in-house for customers. While maintenance of a current file of all endowment holdings involves some extra work, Merrill offers the lowest price for extensions and total. At 25¢ per quote with a minimum of about $400 dollars a year, this service is recommended for institutions

with portfolios over 100 issues (40 or 50 bond issues included) without securities accounting systems.

Bond Indices

Merrill Lynch is just making publicly available 50 to 60 bond indices with four years of historical data. These will include master indices for the market as a whole as well as individual ones classified by type of issuer, quality of bond, and maturity. Additional sub-indices based on coupon category will be available for some of the larger categories. These indices have been constructed to represent the entire investment grade (Baa and above) bond market.

About 4,000 issues are included, more than 99% of taxable institutionally traded debt. Total return is calculated for each index, based on the market value of all the issues. While the information necessary to determine the coupon part of the total return is available, it will not be supplied separately for some time. To make the indices as market-like as possible, coupon payments are credited when paid instead of on an accrual basis, as the Salomon index does. Merrill's indices do not include any issues of less than BBB quality, but since few institutions hold lower quality bonds than this, it is not a major shortcoming.

Merrill's superior pricing capabilities coupled with careful construction will probably make these market-value weighted, total return indices the best ones available for measurement of relative performance of bond portfolios, but final judgment must be reserved until the data have been published and tracked for several quarters.

Conclusions

THERE IS MUCH DISAGREEMENT within the bond industry concerning the best system of bond valuation, but if the endowment manager closely examines the available systems and considers his or her own operating constraints, then the best alternative becomes fairly clear. First, managers must deal with the cost versus market disagreement. For life insurance companies with fixed, long-term liabilities, market valuation of bonds is not critical. For institutions where liabilities do not form a predictable pattern and are subject to inflation, the present value of bonds is essentially the only meaningful figure. Carrying bonds at cost ignores both opportunity lost for coupon reinvestment as well as any relative performance toward a set of objectives. This is especially true for educational endowments, where unit share values require current market pricing and where budget problems have made a realistic assessment of sources of funds and future opportunity mandatory.

Another much-discussed problem in bond pricing is which price to use: the bid, the ask, or the last trade. Which is the most relevant? The answer here is almost as clear as the answer to the first problem. The great majority of institutions valuing their own assets are slightly conservative, and use the bid price. New federal legislation applicable to many institutions makes managers that overrepresent their assets clearly liable. Some institutions, such as bank trust departments, are required by state law to use last-trade prices where they exist, and this is the impetus for services to carry Big Board last-trade prices. A few institutions do price on the ask side of the market, but in general they are pricing bonds they manage for other institutions or individuals, and not their own bonds. Thus, for comparability, as well as to be conservative in setting financial goals and objectives, the bid price should be used to value bond assets.

The last question—which source and pricing method to use—is still a complex argument, but it can be simplified depending on the user institution's size. For small institutions with less than 10 bond holdings, major pricing effort is unwarranted in either time or money. Such institutions are unlikely to have an active relationship with a major brokerage house, and thus would not be in a position to ask for individual broker quotes except from a small trading firm, where the reliability of some quotes may be suspect. For these institutions, reliance on published lists of market quotations is the easiest and cheapest.

Of the services that make available hard-copy lists of their bond prices, only three make available a comprehensive list at little or no cost: Salomon Brothers, Moody's, and Standard & Poor's. For an institution without time constraints when figuring its monthly endowment value, Moody's and Standard & Poor's are the most convenient. Both can be obtained in hard copy at little or no cost, and are accurate and reasonably comprehensive. For small institutions that must have bond valuations fairly promptly, Salomon Brothers is probably better than any other because there is no charge for this service. While information must be received by telephone (a little less convenient than hard copy), prices are excellent and are available three days after the month's end. The universe of bonds covered is good, and a Salomon trader will probably price on request the few issues not covered. For institutions with very small issues or private placements, not covered by Salomon, S & P, or Moody's pricing lists, the institution will be unable to value them except through an individual bond trader. In valuing these bonds, some attention should be paid to the source of the quotes. The institution should try to find a bond trading house with an active interest in the kind of issue held. More than likely, even though no business has been transacted, a trader will price issues of interest to him on the chance that future business may ensue. Bond traders also like to know who owns particular issues, and in what quantities, to match future buyers and sellers. Such a bond trader would also be most likely to know and understand the specific features of any issue held, in order to give a reasonably accurate price. Inquiries about the bond houses active in each market should be directed to any local financial institution such as a bank, insurance company, mutual fund, or investment adviser.

For an institution with a medium-size bond portfolio of 15 to 30 issues, its own constraints may determine how it prices bonds. If such an institution has an active relationship with a major bond house—in particular, Salomon Brothers—then even this larger group of bonds could be priced by telephone. Institutions without such a relationship will have to use one of the major pricing services. For institutions that are not rushed to release portfolio values, the best service is Merrill Lynch, because of its low cost. The total bond spectrum is documented by Merrill Lynch in its universe book, which may be purchased for $250 a year in hard dollars, or $1,000 a year in commissions. While the 8,500 corporate issues covered is a smaller universe than Telstat or IDSI, Merrill Lynch will entertain requests to price private issues as well as extremely illiquid public issues not already included in its corporate universe. Telstat's similar monthly hard copy universe is $750 a year. All three services will price a small user's entire portfolio, including extensions and totals, for $400 or $500 a year, but this requires that the user keep the service totally up-to-date on all transactions in the portfolio. This usually proves to be a major inconvenience, so that use of the hard-copy Merril universe book is recommended for medium-sized noncomputerized institutions. For institutions that cannot wait five days, the speedy hard-copy service of Telstat is the obvious choice.

If the institution is computerized, but does not need to purchase the complete pricing tape, Merrill, IDSI, and Telstat will provide individual valuation lists in whatever format the user desires. Merrill is again clearly preferable due to its low

cost in hard dollars and the availability of soft-dollar terms for this product at about 2½ to 1.

For institutions with major holdings in bonds, the question is not so much one of price, in that either the hard- or soft-dollar cost of any pricing service is small compared to the total operational costs of the portfolio. More important here are relative ease of use, timeliness, computer compatibility, and precision. Due to the lack of computer compatibility, Salomon Brothers' pricing cannot be considered in this group. While Kuhn Loeb's product would be available to such institutions, the lower emphasis put on accuracy makes it an inferior product to the Merrill, Telstat, or IDSI systems. The DIC system is basically a combination of already available systems that, until such time as the system works toward a major portion of the bonds being trade-validated, offers nothing that others do not. It should be noted that all of the systems mentioned here are not just bond pricing systems, but also make available other sophisticated performance, accounting, and asset management tools. No consideration is made here for any other such products available; only the bond pricing capability is being examined.

The three systems not yet summarized, Telstat, IDSI, and Merrill Lynch, are all very good. Any of them can be purchased, depending on the user's preference for methodology. Telstat is less expensive than other services, but uses last-trade prices for listed issues. Merrill offers its own evaluation in addition to listed closing prices, but is weaker on very small, low-rated, or near-term securities. In addition, potential users of Merrill's service must be willing to use a matrix system, a term that still carries some stigma in the bond industry.

IDSI is actually the weakest candidate, due to higher price. A larger universe is rather irrelevant, since institutions can have Telstat or Merrill add issues to accommodate user holdings. In addition, since IDSI is both a quote and matrix-based system, it carries some of the matrix stigma, but does not offer the lower potential price of a matrix system.

As a final comparison of Telstat and Merrill, one should look to the future. Telstat has a long-standing reputation for generating a good product. Trader quotes and listed prices cannot, however, always cover the entire range of bonds. Valuation systems of the future, like UBAS, will have to include many actual trade prices, but then will move to matrix valuation for the vast number of remaining issues. Merrill's matrix system is but the start of such a system, and should continue to improve. For the present, though, the evaluation of which service to use will depend on a trade-off between the higher cost of Merrill and its round-lot orientation versus its more consistent valuation and some possible improvement in the future.

SUMMARY TABLE[1]

Service	Moody's	S & P	Salomon	Kuhn Loeb	DIC	IDSI	Telstat	Merrill
Size								
Number of Corporate Issues	5,000+	5,000+	4,000+	4,000	12,000	15,000	10,000+	8,500
Governments and Agencies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Private Placements	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Municipals	No	No	No	No	Yes	Yes	Yes	Yes
Format								
Hard Copy	Yes	Yes	Yes[2]	No	No	N/A	Yes	Yes
Machine-Readable	No	No	No	No	No	Yes	Yes	Yes
Prices								
Prices Available	1	1	1	1	3	3	3	2
Issue Size	50	50	500	1,000	50	50–100	50	250
Days to Availability								
Hard Copy	10	15	3	3	N/A	N/A	1	5
Tape	N/A	N/A	N/A	3	2	1	1	1
Cost								
Hard-Copy Universe	0–100	0–75	0	N/A	N/A	N/A	750	250
Tape Universe Hard $	N/A	N/A	N/A	N/A	3,500	4,000	2,500	5,000
Tape Universe Soft $	N/A	N/A	N/A	N/A	9,000	12,000	7,500	10,000
Cost per Quote	–0–	–0–	–0–	N/A	N/A	25¢	25¢	22¢
With Extensions	N/A	N/A	N/A	N/A	N/A	50¢	35¢	25¢

[1] Information as of March 1977.

[2] Only at Salomon offices.